DOCUMENT RESUME

ED 275 323 IR 012 402

AUTHOR Lowyck, Joost; De Corte, Erik
TITLE Research on Media in Western Europe: A Myth of Sisyphus?
PUB DATE Apr 86
NOTE 29p.; Paper presented at the Annual Meeting of the American Educational Research Association (67th, San Francisco, CA, April 16-20, 1986).
PUB TYPE Information Analyses (070) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Computer Assisted Instruction; Computers; Computer Simulation; *Educational Media; *Educational Technology; Literature Reviews; *Media Research
IDENTIFIERS *Europe (West); *Learning Environments; Teaching Experiment

ABSTRACT

Main trends in media research in Western Europe are identified, with emphasis on three successive stages since 1960: tools technology, systems technology, and reflective technology. Previously, the third stage has not been well elaborated, a statement supported by an analysis of the content and context of European media. A critical appraisal of the present state of the art reveals the lack of a fundamental and theory-based approach in past investigations, which underscores the need for an integration of media studies in current cognitive research on learning and instruction. Work at the University of Leuven serves as an illustration of the growing tendency to design and study educationally relevant and theory-based learning environments that fit into the school curriculum, and in which detailed data are collected on students' learning and problem solving. A six-page bibliography is provided. (KM)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED275323

RESEARCH ON MEDIA IN WESTERN EUROPE : A MYTH OF SISYPHUS ?

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Joost LOWYCK & Erik DE CORTE

University of Leuven, Belgium

Center for Educational Technology
Center for Instructional Psychology

April 1986

Paper presented in an invited symposium on "International perspectives on instructional technology research" at the Annual Meeting of the American Educational Research Association, San Francisco, April 16-20, 1986.

IR012403

BEST COPY AVAILABLE

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Joost Lowyck

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

RESEARCH ON MEDIA IN WESTERN EUROPE : A MYTH OF SISYPHUS ?

J. LOWYCK & E. DE CORTE

University of Leuven, Belgium

ABSTRACT

This paper does not give an exhaustive overview of media research in Western Europe, but attempts to identify some main trends. In the first part three successive stages since about 1960 are distinguished : tools technology, systems technology, and reflective technology. Until now the third stage has not yet been well elaborated, a statement which is supported by an analysis of the content and the context of European media research in the second section. A critical appraisal of the present state-of-the-art reveals the lack of a fundamental and theory based approach in past investigations. Therefore, in part three a plea is made for an integration of media studies in current cognitive research on learning and instruction. This orientation is illustrated with respect to the application of computers in education.

RESEARCH ON MEDIA IN WESTERN EUROPE ; A MYTH OF SISYPHUS ?

J. LOWYCK & E. DE CORTE
University of Leuven, Belgium

1. Introduction

Reviewing media research in Western Europe is a complex task. It is a relatively new, but at the same time a divergent domain due to the cultural, linguistic and political diversity within Western Europe as well as to the differences in research traditions. Especially, the language barrier is a very real one. However, from our own background we have access to the literature in English, German, French and Dutch, which allows a broad spectrum exploration of the available research. Nevertheless, an exhaustive survey is impossible and we will limit our effort to the description of the main trends supplemented by some occasional illustrations. Because we think of programmed instruction as of a learning paradigm rather than a medium, this topic will not be treated in this paper.

Until the early sixties, there was certainly not an abundance of educational research in Western Europe. Unlike psychology in which an experimental and empirical approach of human behavior was important, the study of education was rather philosophical or prescriptive. That most of the educational departments at universities were part of the faculty of philosophy is an institutional expression of this state of affairs. School innovations were not influenced by empirical research but by reform 'movements', inspired by ideas that were deduced from

some philosophical or moral principles about education. Moreover, practical problems in schools were solved by teachers without any need for a theoretical basis.

The turn toward an empirical approach of educational problems in the early sixties has strongly been influenced by the status of educational research in the USA. Complaints about the lack of effectiveness of European school systems in a rapid changing society forced policy-makers and scholars in the field to search for answers to new questions. One of the beliefs was that research characterized by a systematic analysis of the complex reality, could contribute to the solution of these problems.

This explicit attention to education in the western world in general had undoubtedly to do with the fear for arrears as illustrated by the sputnik-shock. Confronted with a lot of practical and theoretical challenges, policy-makers expected that at least in some areas of education media would help solve the problems. Examples are the use of closed- circuit television in teacher education (Schorb, 1969), the computer as a tool for differentiation and individualization at the secondary and special education level (Husen, 1967), educational television and broadcasting for elementary school children (van der Voort, 1969), etc.

However, in almost all countries the position of educational technology has been criticized, bringing conservatives and progressives together in their negative attitudes (Flechsig, 1970). The former claim the "dehumanization" of education through technology, while the latter fear the manipulation of information by the policy-makers. Therefore, the study of media was rather stepmotherly threatened by scholars in the field, and remained largely an activity of enthusiastic practicians, using some theoretical concepts to embellish their reports. Consequently it is not surprising that we do not find a strong theoretical tradition in the field of educational technology.

Over the past twenty years a number of media have succeéded each other; however, the theoretical gap remained. Therefore from a research point of view, the question raised whether the study of media looks like the work of Sisyphus, the king of Corinth condemned forever to roll his stone up a mountain in Hades only to have it roll down again when nearing the top. Is there some progress in European research on media and if so, how can we describe the state of the art ?

2. Technology and media research

Technology in general and educational technology in particular have been differently defined in the educational literature, depending upon the theoritical aspirations or the pragmatic delineation of the field of study. Bunge (1967), characterizes the object of technology as follows : " For technology, knowledge is chiefly a means to be applied to the achievement of certain practical ends. The goal of technology is successful action rather than pure knowledge". This demarcation of technolgy has been accepted by the authors of the document Educational technology for permanent education : a critical reappraisal, sponsored by the Council of Europe (1980). They use some criteria to define more precisely the boundaries of educational technology by asking the following questions :

- What distinguishes educational technology from an educational theory or from educational practice ?
- What kind of knowledge is used in educational technology and how is it produced ?
- Is there some evolution in the concept of educational technology during its history ?

With respect to the last question many authors have distinguished two main phases, namely the tools technology and the systems technology. Because of the inherent limitations of these approaches, a third type has been labeled " reflective technology". We will look closer at these three types.

2.1. Tools technology

Educational technology was first conceived of as the application within schools of tools, devices, instruments, media or hardware widely available outside the educational system. Husen (1967) has well defined this way of using technology : " To be sure, various media in widespread use elsewhere, such as motion pictures, radio and television, have in several countries been made available to the school, but they have not been successfully integrated into existing conventional practices and teaching aids. The new "gimmicks" have been introduced in a piecemeal fashion as something extra, but not essentially geared to the core of the teaching- learning process". Many articles in journals on media follow this line of reasoning : teachers and policy-makers are confronted with "satellite"- media, like slides, overhead-projectors, 8 mm movies, computers, etc.
This tools technology framework leaves the conception of teaching and learning unchanged. Saving of time and energy for the consumers of education is the main promise.

However, the new media unexpectedly cracked the solid walls of the classroom : through hidden forces they changed certain objectives, strategies and organizational aspects of the school system. A clear example is the radical change of language teaching from reading and writing towards listening and speaking in the language laboratory by the use of sound- recording and feedback.

The dominant trend in the early days of the tools technology, namely to compare different media in search of the most effective tool was later on replaced by an interest in the peculiar characteristics of hardware in terms of "media attributes" (Heidt, 1976).

2.2. Systems technology

The inadequacy of the isolated tools-technology approach forced researchers to explore new avenues in their endeavours to contribute to the solution of the complex problems within the educational system.

Along with the principles of instructional design the use of media was embedded in the broader "systems approach". Attention was paid to the definition of objectives and the search for effective means to realize them.

Within this approach, both the integration of new media into the curricula and the sharper definition of the learning paradigms, were taken for granted. Especially the estimated effectiveness of programmed instruction led to well elaborated media-environments, such as multi-media systems, complex teaching-machines (Zielinski & Scholer, 1964), individualized packages (Karow,1971), etc. In the same line of development, the impact of mass-media on academic learning was investigated for example in the case of distance learning. The concept of the open university as a vehicle for raising the educational level of deprived or disadvantaged people is one of the most outstanding products of the systems theory. In this respect there was a close connection between ideological or political arguments (Vaizey,1962) and expectations of a technological solution.
While during the tools-technology phase one was mainly interested in the possibilities and the characteristics of the hardware, the systems technology focused on the development of software and teaching-learning materials.

In the mid-sixties an upsurge of technological development in Western Europe took place, especially under the influence of the representants of the systems analysis approach in the U.S.A. (Glaser, 1965; Gagne & Briggs,1974). The shift from the philosophical deduction of teaching and learning principles towards an empirical approach is tributary to the overwhelming promises of the systems approach. In almost all Western European countries intensive endeavours have been invested in the elaboration of didactical models and their different components (operationalization of objectives, analysis of entry-behaviors, curriculum development, teaching methods, media, evaluation). Meanwhile, educational technology has been acknowledged as a specific domain focusing on the development of a well- controlled learning environment with the help of several media. At that time, several

journals started in Europe, e.g. Audiovisual media (1967-1970), changed in : Educational media international in 1971; Bibliographie Programmierter Unterricht (1965-...); British Journal of Educational Technology (1969-...); AV Forschung (1968-...); Fernsehen und Bildung(1966-...); Geprogrammeerde instructie (1968) changed in :Onderwijs en media (1969-1977); Programmiertes Lernen, Unterrichtstechnologie und Unterrichtsforschung (1963-1972) changed in : Unterrichtswissenschaft in 1973; Programmed learning and educational technology (1963-...). As indicated, many of the original journals disappeared or were absorbed in journals with a broader focus.

At the same time, several technological institutes were founded, like : " Stichting Film en Wetenschap" and " Nederlands Instituut voor Audiovisuele Media" in the Netherlands; " Institut für Film und Bild in Wissenschaft und Unterricht" and " Forschungs- und Entwicklungszentrum für objektivierte Lehr- und Lernverfahren" in Germany; "Centre Audiovisuel, Ecole Normale Supérieure Saint-Cloud",and two special divisions of the "Institut National de Recherche en Pédagogie ", namely :' Groupe de recherche sur les Applications Educatives de la Télématique et des Télécommunications' and ' Division Informatique et Enseignement' in France; " British Film Institute"," National Audio Visual Aids Centre and Library", " The Open University", with two important subsections :' The Committee on Communications Technology' and 'The Institute of Educational Technology' in the United Kingdom.

The institutionalization of the technological approach results from both the economic expansion during the late sixties and the technological way of thinking about innovations in schools and education. It is only after a period of intensive experiences with the media, that the limitations came to light. Moreover, educational technology was mainly focused on the development of materials, while more basic research questions remain uncovered. We agree fully with Salomon's (1979) statement, which applies rather well to the status of media research in Europe as well : " I found to my surprise that

the field was generally atheoretical and far behind contemporary advances in psychological research".

2.3. Reflective technology

The lack of a theoretical orientation in media research is accounted for in different ways. Samson (1985) mentions the inadequacy of the research questions as one of the main shortcomings. In his opinion, research projects are started too soon, i.e. without translating the broader problem into more precisely defined and operationalized subquestions. If investigators would be more specific and rigorous in this respect they would arrive at significant questions that can be related to broader domains of research having already a more or less substantial theoretical base such as instructional psychology and information-processing research.

Another source of dissatisfaction with the systems technology is the almost exclusive focus on so- called operational knowledge. Ahlstrom, Lindblad & Wallin (1977) notice a predominant position of the operational over substantial knowledge. In this case, educational technology is rather characterized by the elaboration of strategical models for planning than by substantial knowledge on which different decisions could be based. As a consequence of the lack of substantial knowledge, educational technology became eclectic (Council of Europe, 1980) and remote from value-based, reflective or philosophical considerations. The isolation of the means, without control over the complex and unplanned effects in the complex situation, led often to hidden or unintended ends. We already mentioned the switch of objectives in language learning due to the characteristics of the language laboratory.

In their final report Educational technology for permanent education : a critical re-appraisal, the authors described roughly the following features of a reflective technology :

- Knowledge is derived from both scientific and experiential sources ;
- It draws upon substantial as well as operational knowledge and recognizes the primacy of the former ;
- The different forms of knowledge have to be integrated and should be consistent with an explicit value perspective ;
- It is reflective insofar as those using it reflect upon both the technology and its products. Such a reflection, however, is a necessary element in research on media.

This position seems to integrate the phil osophical and normative tradition of the educational sciences in Western Europe within the rationality of an empirical means-ends approach. The pure descriptive approach is abandonned and the concern for the attainment of values is seen as an essential aspect of technology. However, this reflective technology approach seems at present still a declaration of intentions ; indeed it is not yet obvious how this alliance between the operational and substantial type of knowledge as well as the combination of the descriptive and prescriptive approaches will be translated in a substantial, methodological and logistic paradigm of media research (Gage, 1972).

3. Content and context of media research : a critical appraisal

It is well-known that in educational innovation, the incentives for change are mostly forthcoming from very pragmatical needs. In this connection "new media" were often perceived as powerful tools for the solution of educational problems. In order to gain insight into the state-of-the-art of media research in Western Europe, we will first review the main topics as represented in the journals mentioned above. In view of understanding more fully their practical and theoretical importance, we will consider examplarily and critically the context of media research.

RESEARCH ON MEDIA IN WESTERN EUROPE

3.1. Overview of the main topics in educational technology

Using the indexes per volume of the media journals mentioned above, we classified the most pregnant topics, without however evaluating systematically the quality of each article. First, it is difficult to use unequivocal criteria for such an evaluation as one should take into account the target group as well as the objectives of the journals. Second, the choice of the journals is not the result of a rigorous sampling, but a rather factual collection. Neverheless, these journals surely reflect the main interest points in media studies. Third, as there is a difference in the scientific status of the journals, the articles reflect both theoretical and practical interests.

Introduction of new tools

In many articles the introduction of new tools or the didactical use of already well-known media is described. The introduction of video and instructional television, the use of schoolradio, overheadprojector, 8 mm and 16 mm films, slides or computers are examples of such an "import". The quality of the tools is taken for granted and the only new information consists of a narrative exposition of how well these tools could fit into the classroom. When a tool is new, it is almost never the object of criticism.

Organizational problems

Another topic refers more explicitly to organizational problems of the integration of new devices into the school. Here too, more practical experiences are reported. Teachers, research groups or curriculum developers inform the reader about the way new tools can be integrated into existing situations. These articles usually warn against the neglect of some critical aspects of media use, e.g. the optimal duration, the minimal level of concentration in children, the preparatory activities, the integration into already existing programs, etc.

Reports of experiences in foreign countries

Sometimes, experiences during study trips are reported. They try to inform the reader about realizations in other countries hoping mostly that these innovations will be used in the own situation. Examples are : the description of games and simulations, new software products, peculiar uses of distance learning, policy- making about new media, institutionalization of courseware development, etc.

Psychological and sociological impact of media

Several articles report different psychological and sociological effects of mass-media, like the influence of television on political opinions and its effect on drug consumption, agression, use of leisure, etc. Other topics are : the impact of media on motivation, feelings and emotions, the reduction of anxiety, the suitablility for specific aptitudes. These field of study is mainly covered by journals from Germany and Great Britain. Other contributions describe the effects of media on cognitive development, on the quality of processing pictural and verbal information and of problem solving. In most of these articles the link with psychological and sociological models or theories is stressed (see e.g. Peeck, 1972; Heidt,1974).

Use of media in the curriculum

The desirability of media use in different subject-matter fields is often demonstrated. Examples are : the use of microcomputers for problem solving in dynamics, the suitability of video for teaching geography, history, and sports, the integration of simulation packages in electronics, the use of language laboratories and computers for reading and writing,the use of closed-circuit television in teacher education programs, etc. Sometimes, articles focus on the transmission of experiences with media in one school level to another one, e.g. from higher education to secondary schools.

Development of media centres

Often, information is given about the structural and organizational characteristics of media centres, learning resource centres, tasks of media specialists, etc. In many cases these contributions start from a description of the functions of a centre, and try to show the suitability of the structural and organizational features. The collaboration of a media centre with other educational institutions is rarely suggested. The focus is rather on the technological side and not on the instructional functions. There is a manifest trend towards isolation of the technological aspects from the broader educational context; this is obviously contrary to the basic idea of the systems approach at the micro-level.

Reflections on the state-of-the-art in media research

Although restricted in number, some articles focus on the state-of-the-art of educational technology research. Moreover, the concept of technology is refined and some building blocks for a theoretical framework are presented. The writings by Husen (1967), van Gelder (1969), Flechsig (1970), Heidt (1974), Jaspers (1972-'73), The Council of Europe (1980), and Strittmatter & Seel (1984) are a few examples. In their contributions, a continuous struggle with conceptual, theoretical and methodological problems is revealed, and consequently, the lack of a consistent framework for thinking and investigating is made clear. At the same time, communication difficulties between researchers from different countries are obvious. Nevertheless, this activity, consisting in building blocks of a possible common framework seems to us a very important scientific contribution. Indeed it constitutes a step towards the consolidation of media research, and helps to overcome the narrow bounderies of countries and languages.

Generally speaking the preceding overview of the topics in the Western European literature on educational technology shows a predominant pragmatic and practical approach of media. Apart from a scarce number of theoretically well-founded articles, the absence of both a systematic reflection and a consistent theoretical framework is pertinent. The surface features of media and their organizational

context are undoubtedly predominant. The aspirations of the reflective technology approach, in which the aims and values of the educational situation constitute an integrative part of the study object, are certainly not yet realized. If the media literature remains isolated, we will observe a myth of Sisyphus, i.e. an unfruitless repetition of the same errors and pitfalls in different situations with different media, how technologically advanced they may be. Only a strong theoretical framework will enable us to make substantial progress in understanding of the power and weaknesses of media to support teaching-learning processes. In this perspective we agree with the important conclusion from Clark's (1983) analysis of media research : " It seems reasonable to assume, therefore, that media are delivery vehicles for instruction and do not directly influence learning. However, certain elements of different media, such as animated motion or zooming, might serve as sufficient conditions to facilitate the learning of students who lack the skill being modeled. Symbolic elements such as zooming are not media (we can have a film or television program which does not contain zooming) but allow us to create sufficient conditions to teach required cognitive skills".

3.2. The context of media research in education

In almost all countries, education is confronted with new problems and as already suggested above,policy-makers as well as researchers sometimes seem to expect a quick solution from using media.

A clear example is the closed circuit-television in teacher training. The expected shortage of teachers for the sixties and seventies (Picht, 1964 ; Vaizey, 1962), forced teacher training institutes to recruite many students. In their practical training, the student-teachers had to participate in teaching activities in elementary and secondary schools. However, the observation and participation facilities were restricted. Relying on the possibilities of video recording, teacher trainers believed that a lot of training activities

could be organized in the institutes using video observation and feedback as a tool. This led to an almost unlimited number of reports, articles and initiatives focusing on the use of video in teacher training. They all treated the same phenomenon : the introduction and use of video. Applying micro-teaching and classroom observation, student teachers were trained in different teaching skills. Self-confrontation (Bierschenk, 1969, 1972), video-observation (Schorb, 1970 ; Meyer, 1966), micro-teaching in small groups (Zifreund, 1966), all used video as a tool. However, very few attention was paid to the effects of this isolated training device nor to its ecological validity.

Bierschenk (1972,1976) was one of the first European investigators to measure the effects of self-confrontation via closed-circuit television in an experimental setting. He concluded : " If the experimental results are interpreted purely pragmatically or from the point of view of economy, it might seem reasonable simply to recommend the cheapest alternative, i.e. the student teachers seem to need no externally mediated self-confrontation via CCTV/VR, since the experimental conditions have not led to any demonstrable main effects".

In an empirical study of the effects of video registration on the classroom behavior of teachers and pupils in an ecological setting, Lowyck (1978, 1979) observed an important change in the behavioral patterns of teachers and pupils as well as in their interaction. The introduction of the camera in the classroom, especially its specific position and narrowed focus result in a strongly reduced "context" of the video registration. If this registration is then used to inform the student about the events in the classroom and the quality of his/her teaching, one must take into account the possible reduction of reality.

Another example of reductionistic thinking is often shown in connection with the introduction of computers in education. Claiming the necessity of differentiation and individualization of the

teaching-learning situation, many authors consider the computer as the definite and approved solution. However, almost no research evidence is available supporting the positive effects of computers on individual learning, and it remains unclear what kind of individualization is meant or what aspects of childrens' personality such a differentiation is aiming at. De Brabander, Beishuizen & de Jong, (1977) strongly criticized this superficial way of thinking about individualization and elaborated a research proposal which goes far beyond the usual computer literature. In a pilot study they first described the different instructional functions within an individualized learning environment. Using this inventory as a platform, the contribution of media has been analyzed ; not only the instructional value, but also the ergonomic, economic, organizational and technical implications were taken into account.

In summary, the overview of the content of the media literature in the preceding section as well as the critical discussion of a representative example of media studies, reveal the obvious lack in this domain of fundamental research guided by well-founded questions. This is the major reason why so much literature is produced by zealots and so few arguments are theoretically sound.
Besides the need of a more theoretical approach in media studies, the methodological aspects should also be improved. Indeed, in this respect the confounding in computer research discussed recently by Clark (1985) as a representative and reoccurring problem in media investigations in the U.S.A. holds also for a large part of the studies in Western Europe. Taking into account the context of this work, this is hardly surprising.

4. Towards an integration of media studies in more fundamental research

The preceding discussion strongly points toward the necessity of a more fundamental approach in which media research is integrated with theoretically oriented work aiming at a better understanding of the course and the results of teaching-learning processes.

Since the early eighties the microcomputer is the most challenging educational medium from a practical as well as from a theoretical point of view. Therefore we will focus the present discussion exemplarily on this medium; moreover, because in our opinion the application of information technology to education will in the near future offer ample opportunities for the integrative use of different media in teaching-learning environments.
Although there are - as mentioned above - some prefigurations in the writings of several authors, of a concern with theoretical issues in Western European media research, it seems to us that investigators as well as developmental workers have until now often tended to start again in some sense in the tools technology stage, focusing mainly on the effectiveness of the computer as compared to other practices, especially to conventional classroom instruction, a kind of studies that, as Clark (1985) has rightly contended, should strongly be discouraged. Furthermore, although there are rather general complaints about the low quality of the available software, the developers of these materials do not seem to be very much interested in how their products fit into the curriculum, how it relates to learner characteristics, and how it can be appropriately integrated in the complex teaching-learning process as a whole. Finally, claims are made - even in the news media - about the positive effects of computer experience on pupil's learning and thinking skills, although they are not supported by empirical evidence.

As scholars who are interested in phenomena of learning and instruction, it is time for us to take advantage from the lessons taught by our experiences with media research in the past decades, and to move straightforward towards the more fundamental, theory-based study of the use and implementation of media, especially the new information technologies, in the educational process. We should be

aware of the pitfalls and hindrances on our way in that direction, e.g. the fact that the priorities of researchers are oftentimes contrary to those of policymakers and of educational practice (Heene & Plomp, 1985). On the other hand the current state-of-the-art of cognitive science and artificial intelligence in general, and of cognitive instructional psychology in particular presents us with an excellent theoretical framework, and a set of powerful tools that can facilitate the intended integration of media studies with the more general domain of research on learning and instruction. It is without doubt that endeavours in that direction can produce multiple benefits : on the one hand a better understanding of the influences and effects of technological devices as tools of the intellect (Olson, 1985), but also as stimulators of learning motivation and as facilitators of social interaction; on the other hand a deeper insight in the processes of knowledge and skill acquisition, and in the influence of instructional interventions on these processes, two main objectives of instructional psychology (Resnick, 1983).

There are signs that recently in different Western European countries a favorable development in the desirable direction described above - albeit slowly - has started. Without trying to be exhaustive the following more or less related main trends support this statement.

- First, there is a growing interest in the search for educationally relevant and valid guidelines and criteria for software development and evaluation (see e.g. Kanselaar et al., 1985).
- Second, the application of AI to education, especially the development of intelligent tutoring systems, has stimulated research in which attempts are made to model human knowledge underlying performance and to simulate knowledge acquisition processes (see e.g. Mandl & Fischer, 1985). In this connection we mention that in 1985 two international conferences on AI and Education were held in Western Europe : one at the University of Tu¨bingen, West-Germany, and the other at the University of Exeter, United Kingdom.
- Third, the discussion of the last few years concerning the pro's and con's of learning children to program has stimulated investigations

concerning an everlasting problem in educational psychology, namely the possibility of achieving transfer of learning and thinking skill (De Corte & Verschaffel, in press), a topic that nowadays receives a revived interest in instructional psychology in general (see e.g. Chipman, Segal, & Glaser, 1985; De Corte, Lodewijks, Parmentier & Span, in press; Segal, Chipman, & Glaser, 1985).

- Fourth, there is a growing tendency to design and study educationally relevant and theory based learning environments that fit into the school curriculum, and in which detailed data are collected on student's learning and problem solving (e.g. Hoyles, Sutherland, & Evans, 1984). It is obvious that this line of work is also significant with respect to the issue of acquiring generalizable conceptual knowledge, thinking and learning skills.

Our own work at the University of Leuven relates to this latter trend, and will therefore be used here as an illustration.

Two projects are in the design stage and will be mentioned briefly. The first one aims at studying the effects of computer experience on the learning and thinking skills of children at the end of the primary school, taking into account the rather disappointing results of previous work done especially in the U.S.A. (see De Corte & Verschaffel, in press). A central concern in this project is the development of a powerful learning environment, i.e. an environment in which ample opportunity for active and indepedent exploration of learning tasks by the children will be combined with a sufficient amount of systematic intervention explicitly focused on the acquisition of basic concepts and thinking skills. Easy access to the computer will also be a feature of the learning environment. In contrast with most former studies we will not use learning to program as such. Instead we intend to work with software tools related to regular subject-matter domains such as mathematics (using Logo), language (applying text processing), and social studies (using data bases).

A second project focuses on the integration of language skills development and computer literacy in less able pupils from vocational schools (Lowyck, Decoo & De Gelder,1985). Starting from cognitive models of reading and writing (see e.g. Hayes & Flower, 1980; de Beaugrande, 1984; Bereiter & Scardamelia, 1983), the reading-writing process is analyzed. Using systematic information on how these pupils function at the language level, a computer learning environment will be designed. The computer software is produced in accordance with the findings from the descriptive research and aims at different levels of complexity, such as : spelling, wording, sentence construction, text structuring. The work starts from a functional approach of language learning including writing, reading, speaking and listening; in this perspective learning is organized in small groups. For these several language functions, specific programs are elaborated as part of an integrated instructional approach. It is expected that the outcomes of the study will be contribute to the process analysis of language learning in less able pupils, but will also yield a framework for the development of very concrete programs for this ability group.

The data analysis of a third study (De Corte, Verschaffel & Schrooten, in preparation) is now in its final stage. Recent research has shown obviously that children's errors on arithmetic problems are mostly the result of very systematic, but wrong procedures. Effective instruction and remediation requires that teachers have substantial knowledge and understanding of those incorrect procedures. Being able to diagnose them is therefore an important, but at the same time a complex teaching skill which is in our teacher training colleges oftentimes not very well trained. In the present investigation we used a computer program with student-teachers for studying the acquisition of skill in diagnosing systematic errors, called "bugs", in the algorithms of addition and subtraction. The theoretical background of this study is twofold. On the one hand there is the work of Brown, Burton, and VanLehn on procedural bugs in basic arithmetic skills (Brown & Burton, 1978; Brown & VanLehn, 1982; Burton, 1982). Using computer simulation these investigators have constructed an extensive catalogue of bugs. Starting from this catalogue computer programs can be written in which

a sample of bugs in represented for diagnostic purposes, i.e. the user of such a program has to discover the simulated bugs. On the other hand a process model of competent diagnosing of errors was developed and implemented in the computer program. The model involves two main phases, namely, a hypothesis-generating and a hypothesis-testing stage.

Our program which is based on VanLehn's "Buggy Game", simulates fifteen frequently occurring, incorrect procedures in addition and subtraction. It has been administered individually to ten student-teachers, who each worked about two hours on the computer. To allow a detailed qualitative analysis of their diagnostic activities, all student actions were registered on a videotape connected to the computer. Afterwards a collective paper-and-pencil test was administered to the experimental as well as to matched control group; this test was especially designed to assess student-teachers' diagnostic skill of arithmetic bugs. We hypothesized that through the use of the computer program (student-)teachers can acquire and practice effectively an important teaching skill in a simulated setting, which is much less complex and stress-provoking than the real classroom situation. In line with this hypothesis we found that the average score of our experimental group was significantly better than the result of the control group. However, the extensive data collection during the computer session allows us to do also a very detailed analysis of the cognitive processes of our subjects while trying to diagnose the errors. This analysis is currently finished and promises to reveal interesting findings. For example, there seem to be substantial differences in diagnostic style between subject : some of them come up very quickly with a hypothesis concerning the nature of a bug, while others go through a longer and more systematic hypothesis-generating phase, in which they collect additional information before stating their assumption. Another provisional result relates to the differences in precision and correctness of the hypotheses produced by our subjects.

Media research seems to be in a crucial stage, in the sense that, if well conceived along the lines described and illustrated above, it has the potential of contributing in the long run substantially to theory building concerning teaching-learning processes. However, this work could at the same time produce high quality software that can appropriately be used in educational practice. Of course, in the intended kind of research a balance must be achieved between internal and external validity, and - as we already suggested - the current confounding in educational computing research (Clark, 1985) should strongly be reduced. An interesting research strategy within which this can be pursued is the so-called teaching experiment, that has been used in Eastern European instructional psychology since several decades (Kalmykova, 1970; see also De Corte & Somers, 1982). In a teaching experiment, one tries to design favorable conditions for learning based on hypotheses concerning the optimal course of the teaching-learning process. Such hypotheses are developed on the basis of systematic observation and theoretical reflection on the available empirical data. Starting from those hypotheses, a teaching-learning environment that is expected to produce high learning outcomes can be constructed. Through implementation of this environment in a well-controlled situation, it is possible to test the underlying hypothesis concerning the optimal course of the learning process. This kind of experiment is contrasted with so-called ascertaining investigations, in which learning is studied under given conditions without any systematic intervention.

4. Bibliography

Ahlstrom, K.G., Lindblad, S., & Wallin, E. (1977). Notes on educational technology.CCC/ TE ,75, 20.

Bereiter, C., & Scardamelia, M. (1983). Does learning to write have to be so difficult ? In : A. Freedman, I. Pringle & J. Yalden, (Eds) Learning to write : First language, second language(pp. 20-33). New York: Longman.

Bierschenk, B. (1972).Self-confrontation via closed-circuit television in teacher training : results, implications and recommendations. Didakometry, (no. 37, september).

Bierschenk, B. (1976). Selbstkonfrontation über Closed Circuit Television in der Lehrerausbildung : Ergebnisse, Implikationen und Empfehlungen. In : W. Zifreund (ed). Training des Lehrverhaltens und Interaktionsanalyse(pp.470-526). Weinheim/ Basel: Beltz.

Brown, J.S., & Burton, R.B. (1978). Diagnostic models for procedural bugs in basic arithmetic skills.Cognitive Science,2, 155-192.

Brown, J.S., & VanLehn, K. (1982). Towards a generative theory of "bugs". In T.P. Carpenter, J.M. Moser, & T. Romberg (Eds), Addition and subtraction : A cognitive perspective (pp. 117-135). Hillsdale, NJ : Erlbaum.

Bunge, M. (1967). Scientific Research II. The search for Truth. Berlin: Springer.

Burton, R.B. (1982). Diagnosing bugs in a simple procedural skill. In D. Sleeman & J.S. Brown (Eds.) Intelligent tutoring systems (pp. 157-183). London : Academic Press.

Chipman, S.F, Segal, J.W., & Glaser, R. (1985).Thinking and learning skills : Volume 2. Research and open questions. Hillsdale, NJ : Erlbaum.

Clark, R.E. (1983). Reconsidering Research on Learning from Media.Review of Educational Research, 53, 445-459.

Clark, R.E. (1985). Confounding in educational computing research. Journal of Educational Computing Research,1, 137-148.

Clark, R.E., & Salomon, G. (1985). Media in Teaching. In : M.C.Wittrock (Ed.).Handbook of research on teaching. Third edition(pp.464-478). New York: Macmillan.

Council of Europe. (1980).Educational Technology for Permanent Education : A Critical Reappraisal. Strasbourg: Council for cultural co-operation.

de Beaugrande, R. (1984).Text production : Toward a science of composition. Norwood: Ablex.

de Brabander, K., Beishuizen, M. & De Jong, D. (1977). Media in funktie van individualisering van het onderwijs. Pedagogische Studien, 54, 426-441.

De Corte, E., & Somers, R. (1982). Estimating the outcome of a task as a heuristic strategy in arithmetic problem solving : a teaching experiment with sixth-graders.Human Learning,1, 105-121.

De Corte, E., & Verschaffel, L. (in press). Effects of computer experience on children's thinking skills.Journal of Structural Learning.

De Corte, E., Lodewijks, J.G.L.C., Parmentier, R., & Span, P. (Eds.) (in press).Learning and instruction. A publication of the

European Association for Research on Learning and Instruction. Oxford/Leuven : Pergamon Press/Leuven University Press.

De Corte, E., Verschaffel, L., & Schrooten, H. (in preparation). Using a computer program for studying and training the skill of diagnosing errors in addition and subtraction. Leuven : University of Leuven, Center for Instructional Psychology.

Flechsig, K.H. (1970) Die technologische Wendung in der Didaktik. In :G. Dohmen, F.Maurer & W.Popp (Eds.) Unterrichtsforschung und didaktische Theorie. München: Piper.

Gage, N.L. (1972).Teacher effectiveness and teacher education. Palo Alto: Pacific Books.

Gagne R.M., & Briggs L.J.. (1974),Principles of educational design. New York: Holt, Rinehart & Winston.

Glaser, R. (1965).Teaching machines and programmed learning II- data and directions. Washington: Nat. Ed. Ass.

Hayes, J.R., & Flower, (1980). Identifying the organization of writing processes. In : L.W. Gregg & E.R. Steinberg (Eds.), Cognitive processes in writing(pp. 3-30). Hillsdale, Lawrence Erlbaum.

Heene, J., & Plomp, T. (1985). Onderwijs en informatietechnologie : naar en onderzoeksprogrammering. In J. Heene & T. Plomp (Eds.), Onderwijs en informatietechnologie. Verslag van een SVO-COD-Symposium (with an English summary). 's Gravenhage : Stichting voor Onderzoek van het Onderwijs.

Heidt, E.U. (1974). Klassifikationsprobleme von Medien in Lehr- und Lernprozessen. In : H. Dichanz e.a. Medien im Unterrichtsprozess. München: Juventa Verlag.

Heidt, E.U. (1976). Medien und Lernprozesse.Weinheim: Beltz.

Hoyles, C., Sutherland, R., & Evans, J. (1984). The Logo Math Project. A preliminary investigation of the pupil-centred approach to the learning of Logo in the secondary school mathematics classroom. London : University of London Institute of Education.

Husen, T. (1967) Some thoughts concerning educational technology. International Review of Education, 13,6-13.

Jaspers, A. (1972-73). Onderwijstechnologie en mediologie. Tijdschrift voor Opvoedkunde, 18,201-221.

Kalmykova, Z.I. (1970). Methods of scientific research in the psychology of instruction. In E. Stones (Ed.),Readings in educational psychology : Learning and teaching (pp. 125-142). London : Methuen.

Kanselaar, G., Vossen, P., van de Perel, R., Havekes, F., & Stevens, F. (1985). Courseware nader bekeken : een evaluatieinstrument. 's Gravenhage : Stichting voor Onderzoek van het Onderwijs.

Karow. W. (1971). Binnendifferenzierung im Mathematikunterricht- eine Darstellung des schwedischen Unterrichtssystems IMU. In : W.P. Teschner (ed.) Differenzierung und Individualisierung des Unterrichts. Göttingen.

Lowyck, J. (1978) Procesanalyse van het onderwijsgedrag. Leuven, K,U,Leuven, (doctoral dissertation).

Lowyck, J. (1979). A process analysis of teaching K.U.Leuven, Afdeling Didactiek (report no. 21) EDRS- ED 190513.

Lowyck, J., Decoo, W. & De Gelder, E. (1985) Functionele informatica in het beroepsonderwijs en het ontwikkelen van besisvaardigheden in lezen en schrijven. In : J. Heene & T. Plomp (Eds.), o.c..

Lowyck J. (1985).Wordprocessors and the development of writing and reading skills. Paper presented at the 2nd E.C. Summer University, Liege.

Mandl, H., & Fischer, P.M. (1985).Lernen im Dialog mit dem Computer. München : Urban & Schwarzenberg.

Meyer, E. (ed.) (1966). Fernsehen in der Lehrerbildung : Neue Forschungsansätze in Pädagogik und Psychologie. München, Manz.

Olson, D.R. (1985). Computers as tools of the intellect. Educational Researcher,14, no. 5, 5-8.

Peeck, J. (1974). Retention of pictorial and verbal content of a text with illustrations. Journal of Educational Psychology, 66,880-888.

Picht, G. (1964).Die Deutsche Bildungskatastrophe. Analyse und Dokumentation. Olten: Walter.

Resnick, L.B. (1983). Toward a cognitive theory of instruction. In S.G. Paris, G.M. Olson, & H.W. Stevenson (Eds.), Learning and motivation in the classroom (pp. 5-38). Hillsdale, NJ : Erlbaum.

Salomon, G. (1979).Interaction of media, cognition and learning. London: Jossey-Bass.

Samson, G.M.H. (1985). Universitaire audiovisuele centra in een toestand van overgang. In :H.J. Breimer & E.J. van Hees (Eds.) Technologie in het onderwijs. Lisse, Swets & Zeitlinger.

Schorb, A.O. (1970) Unterrichtsmitschau. Entwicklungen und Erfahrungen. Heidelberg: Arbeitskreis zur Förderung und Pflege wissenschaftlicher Methoden des Lehrens und Lernens.

Segal, J.W., Chipman, S.F., & Glaser, R. (1985).Thinking and learning skills : Volume 1. Relating instruction to research. Hillsdale, NJ : Erlbaum.

Strittmatter, P., & Seel, N.M. (1984). Externe und interne Medien : Konzepte der Medienforschung. Unterrichtswissenschaft,9 2-17.

Vaizey, J. (1962). Education for tomorrow. Harmondsworth: Penguin Books.

Van der Voort, T.H.A. (ed.), (1975).Onderwijstelevisie onderzocht: een researchoverzicht. 's Gravenhage: Stichting Nederlandse Onderwijstelevisie.

van Gelder, L. (1969). Onderwijstechnologie : theorie van het onderwijzen. Onderwijs en opvoeding, 19, 203-206.

Zielinski, J., & Schöler, W. (1964). Pädagogische Grundlagen der Programmierten Unterweisung unter empirischem Aspekt. Ratingen: A. Henn Verlag.

Zifreund, W. (1966). Konzept fur ein Training des Lehrverhaltens mit Frenseh- Aufzeichnungen in Kleingruppen-Seminaren. Berlin: Cornelsen.